

Landsat 7 & 8 Long Term Acquisition Plan

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Landsat Long-Term Acquisition Plan

- **Long-term monitoring science mission**

- ◆ Low and mid latitude day-lit descending land – Landsat 7 & 8
- ◆ High latitude and island day-lit descending land – Landsat 8

- **Special Requests and Campaigns**

- ◆ Ascending day-lit land – Persistently-cloudy high-latitude areas – Landsat 8
- ◆ Ocean monitoring – Vegetation; Oil seeps and spills; Ships – Landsat 8
- ◆ Night monitoring – Volcanoes; Urban heat island/city lights; Fire; Geothermal – Landsat 8
- ◆ Priority – Emergency; Field campaigns – Landsat 7 & 8
 - Will attempt to shift maneuvers and calibration activities
- ◆ Calibration and validation – Landsat 7 & 8

Landsat Long-Term Acquisition Plan

- **Sun elevation constraints**

- ◆ Landsat 7 (15° N & 5° S)
- ◆ Landsat 8 (5° N & 5° S)

- **Cloud avoidance**

- ◆ Cloud predictions better than cloud climatology increase probability of acquisition
- ◆ Automatic Cloud Cover Assessments of acquired images identify successful acquisitions
- ◆ Missed opportunity boost

- **Acquire one 10% or better image per year over interior Antarctica**

Landsat Schedulers

CVT & MOC

Calibration
SSR constraints
Power constraints
Duty Cycle constraints
Downlink opportunities
Maneuver reservations

Science Office

LTAP Science
Seasonality file
Land database
Cloud fraction climatology
Thematic prioritization

NCEP

Cloud cover
predictions

Observatory

Reconcile priorities with
observatory resources
(health, safety, physical
constraints)

Scheduling

Collection
Planning

Iterative modeling of inputs
and decision rules
(Science requirements)

Data acquisition

Cloud-cover
feedback

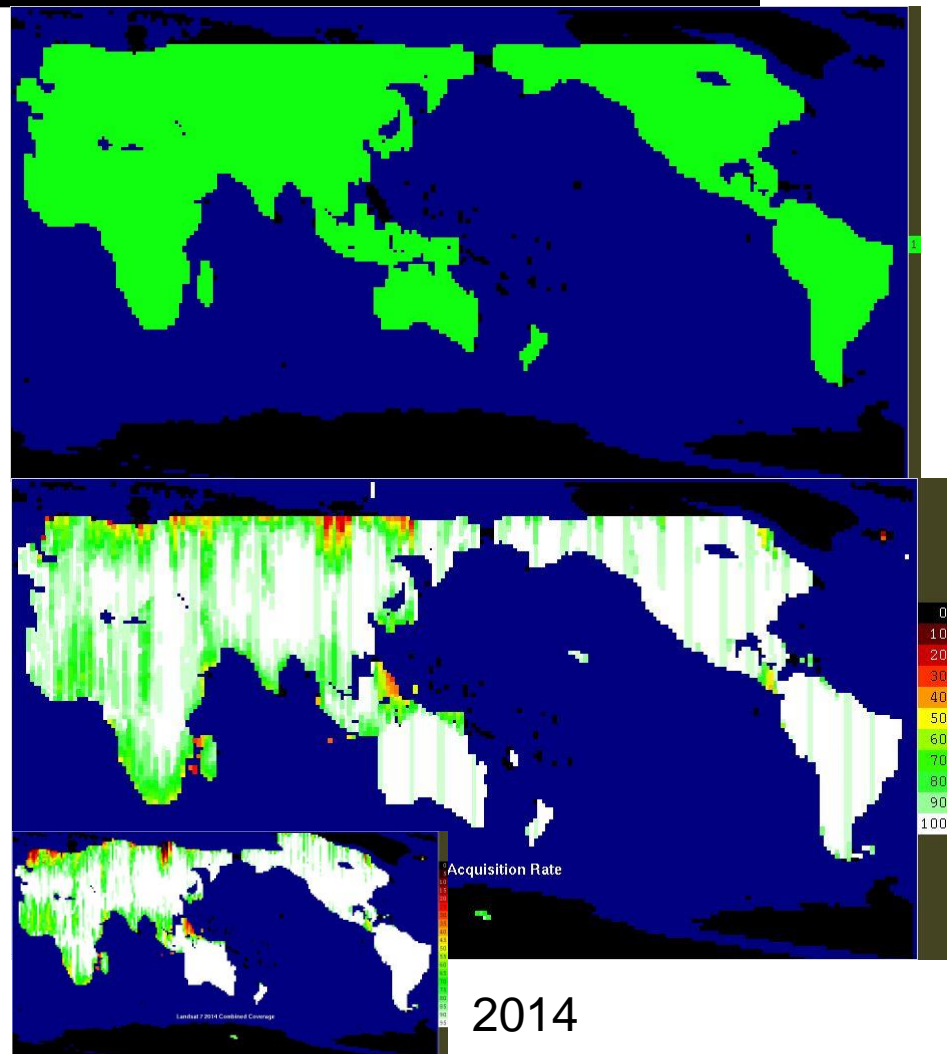
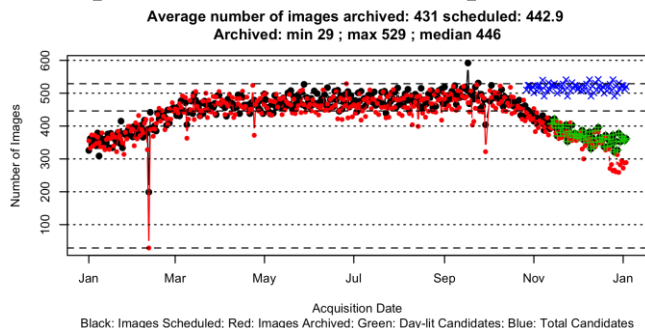
Cloud cover assessments
(ACCA)

User Portal

User and IC requests

Landsat 7 Current Status - 2015

- **Acquire only continental land masses**
 - ◆ minimize revisit time and
 - ◆ maximize interval lengths
- **Most rejects are due to**
 - ◆ duty cycle and
 - ◆ memory constraints
- **No daily limits**
- **Map of 95% acquired**

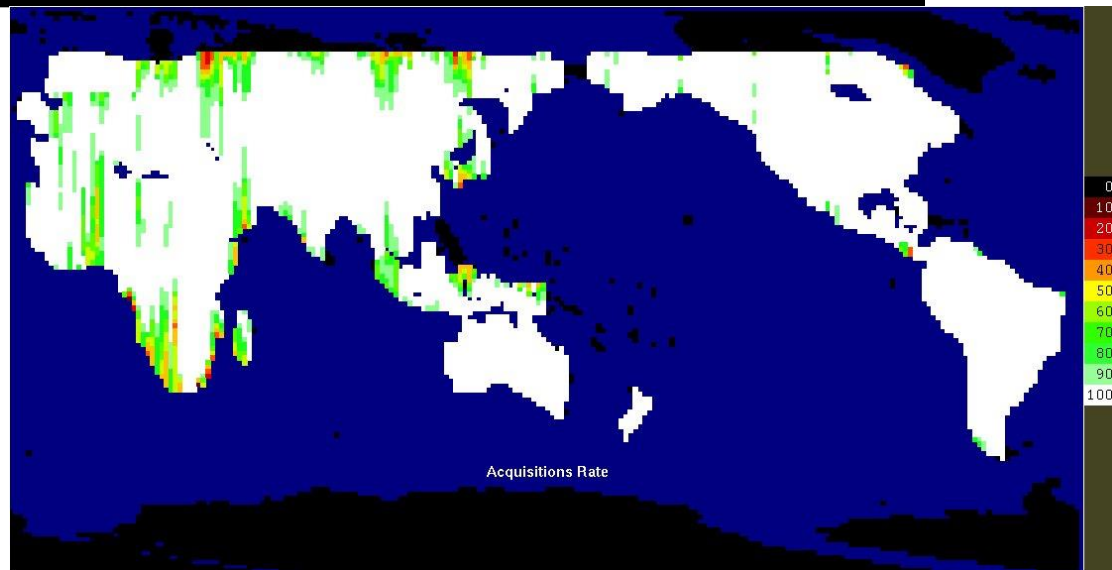


Landsat 7 Goals

- **Tune Landsat 7 Continental Model**
 - ◆ Acquire as many images as possible
 - ◆ Acquire the best possible images
 - ◆ Do nothing to shorten the mission
- **Reduce duty cycle rejections by relaxing constraints**
 - ◆ Duty constraint raised to 105% of current (1 March)
 - ◆ Careful monitoring of telemetry
 - ◆ Duty cycle rejections tend to shift to memory rejections
- **Increase download opportunities**
 - ◆ Add International cooperators as “bent-pipe” LGN stations
 - ◆ Adds operational margin in anticipation of future memory board losses or loss of LGN station

Landsat 7 Models

- Relax ETM+ duty cycle constraints to 105% on 1 March
- Current LGN contacts
- Benefits
 - ◆ 15 additional scenes/day
 - ◆ Fewer power cycles
- Costs
 - ◆ More SSR rejects
 - ◆ Higher percent duty cycle



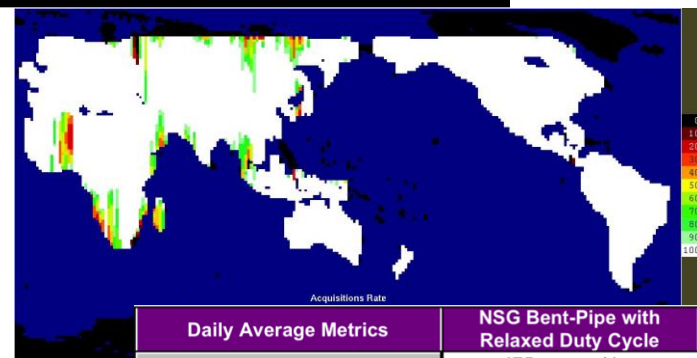
Daily Average Metrics	Baseline
Acquisition Rate (LGN)	460 scenes/day (93.4% of candidates)
ETM+ duty cycle	15.0%
ETM+ power cycles	17.9
SSR Capacity Rejects	0.23
ETM+ Duty Cycle Rejects	31.5

Daily Average Metrics	Relaxed Duty Cycle Constraints
Acquisition Rate (LGN)	475 scenes/day (96.5% of candidates)
ETM+ duty cycle	15.4%
ETM+ power cycles	17.3
SSR Capacity Rejects	1.75
ETM+ Duty Cycle Rejects	15.0

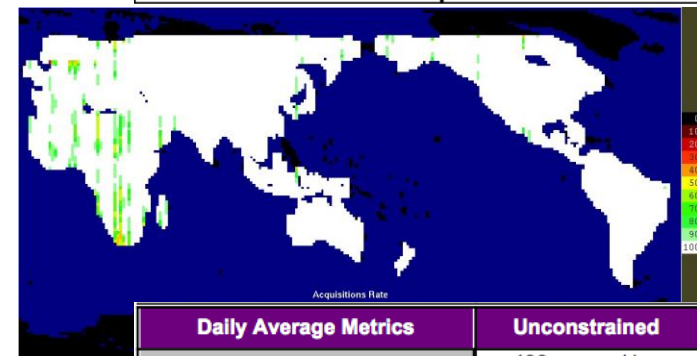
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Landsat 7 Models

- Relaxed ETM+ duty cycle constraints (105%)
- Current LGN contacts plus NSG (Germany)
- Provides margin, but harms distribution
- No ETM+ duty cycle constraints
- All rejections are caused by memory constraints
- What is the value of the 9 extra images?
- Where next
 - ◆ Further Duty Cycle relaxation - more images
 - ◆ Additional Ground Stations – redundancy versus reliability
 - ◆ Clip at row 16 – no need for more stations



Daily Average Metrics	NSG Bent-Pipe with Relaxed Duty Cycle
Acquisition Rate (LGN)	475 scenes/day (96.5% of candidates)
ETM+ duty cycle	15.5
ETM+ power cycles	17.8
SSR Capacity Rejects	0
ETM+ Duty Cycle Rejects	16.4



Daily Average Metrics	Unconstrained
Acquisition Rate (LGN)	486 scenes/day (98.8% of candidates)
ETM+ duty cycle	15.85%
ETM+ power cycles	17.25
SSR Capacity Rejects	5.2
ETM+ Duty Cycle Rejects	0

Landsat 8 acquisitions – 2015

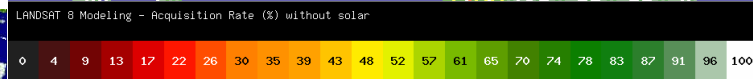
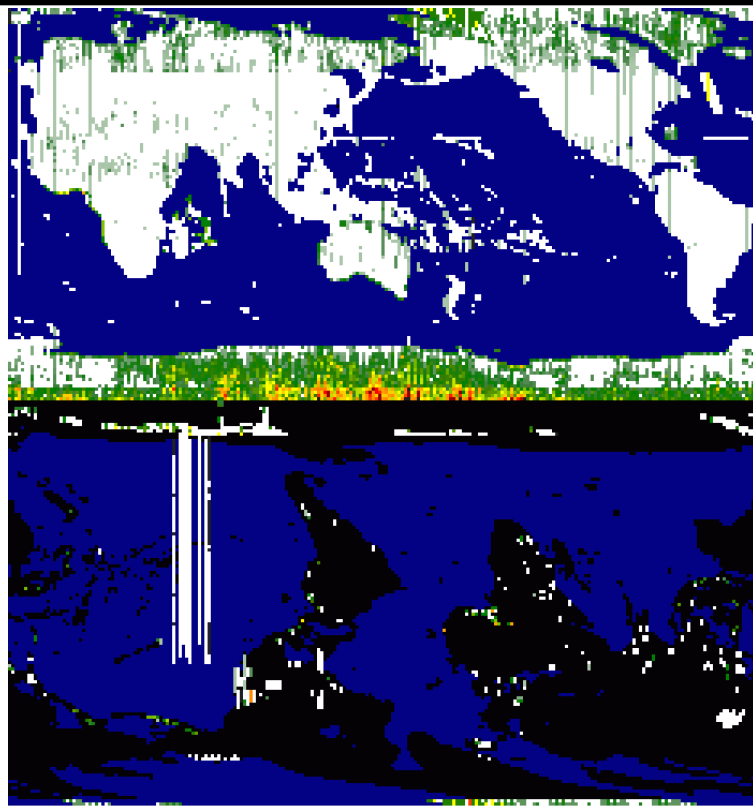
● LTAP status (2015 at 725 images/day)

- ◆ Acquiring 421 of mid-latitude day-lit land scenes (99.5% of candidates)
 - beyond 54° Latitude (rows 20 and 105) there is more than 50% side-lap yielding an 8-day revisit period
- ◆ Acquiring 238 of high-latitude day-lit land scenes (90.5%)
- ◆ Acquiring 13 descending day-lit water scenes/day (98.3%)

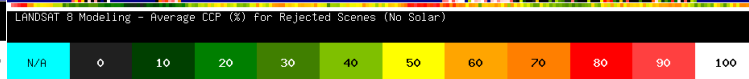
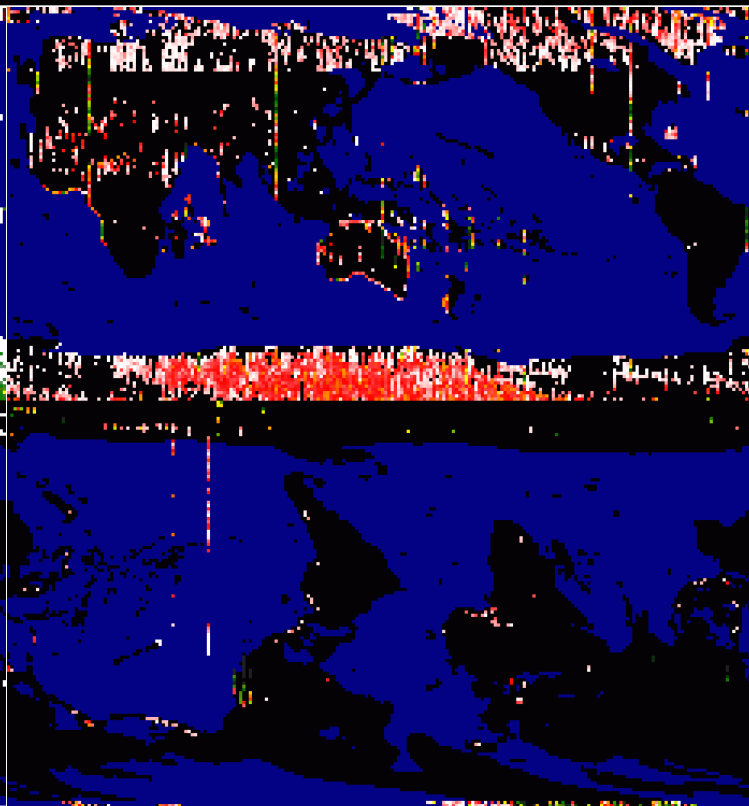
● Special Requests

- ◆ Night requests – 10 images/night
 - Constraint increased from 10 (Jan-Jun) to 20 (Jun-Dec) to 50 (Dec)
 - Volcano (12 requests for 128 scenes)
 - Urban (6 requests for 185 scenes)
 - Fire (12 requests for 96 scenes)
- ◆ Ocean Requests – 16 images/day
 - Arctic sea ice (5 campaigns – 403 scenes – sun elevation constrained)
 - Ocean (10 requests for 181 scenes)
- ◆ Ascending day-lit land requests – 7 images/day (483 Antarctic & 111 Arctic – sun elevation constrained)

Landsat 8 Acquisitions - 2015

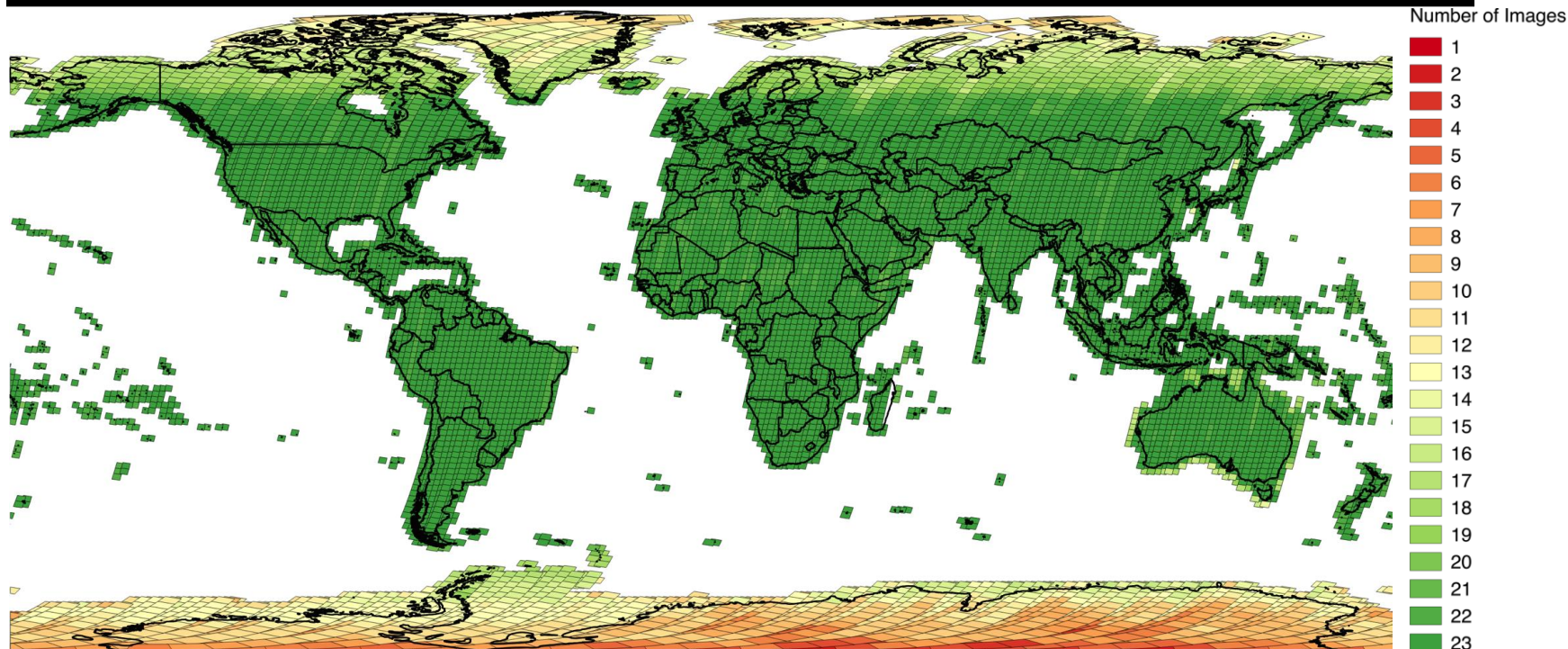


Percent acquisitions

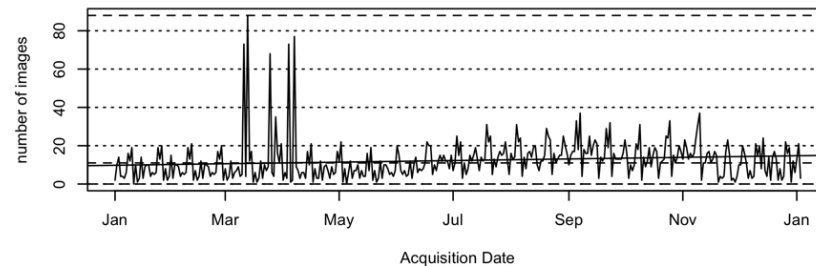
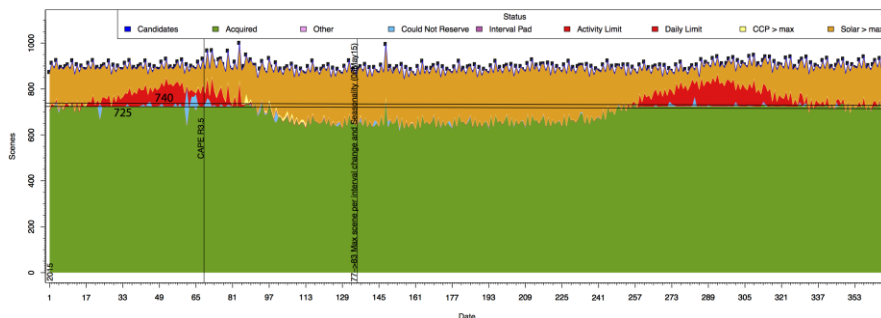


**Average Cloud Cover
Prediction for rejected
scenes**

Landsat 8 – LTAP scenes

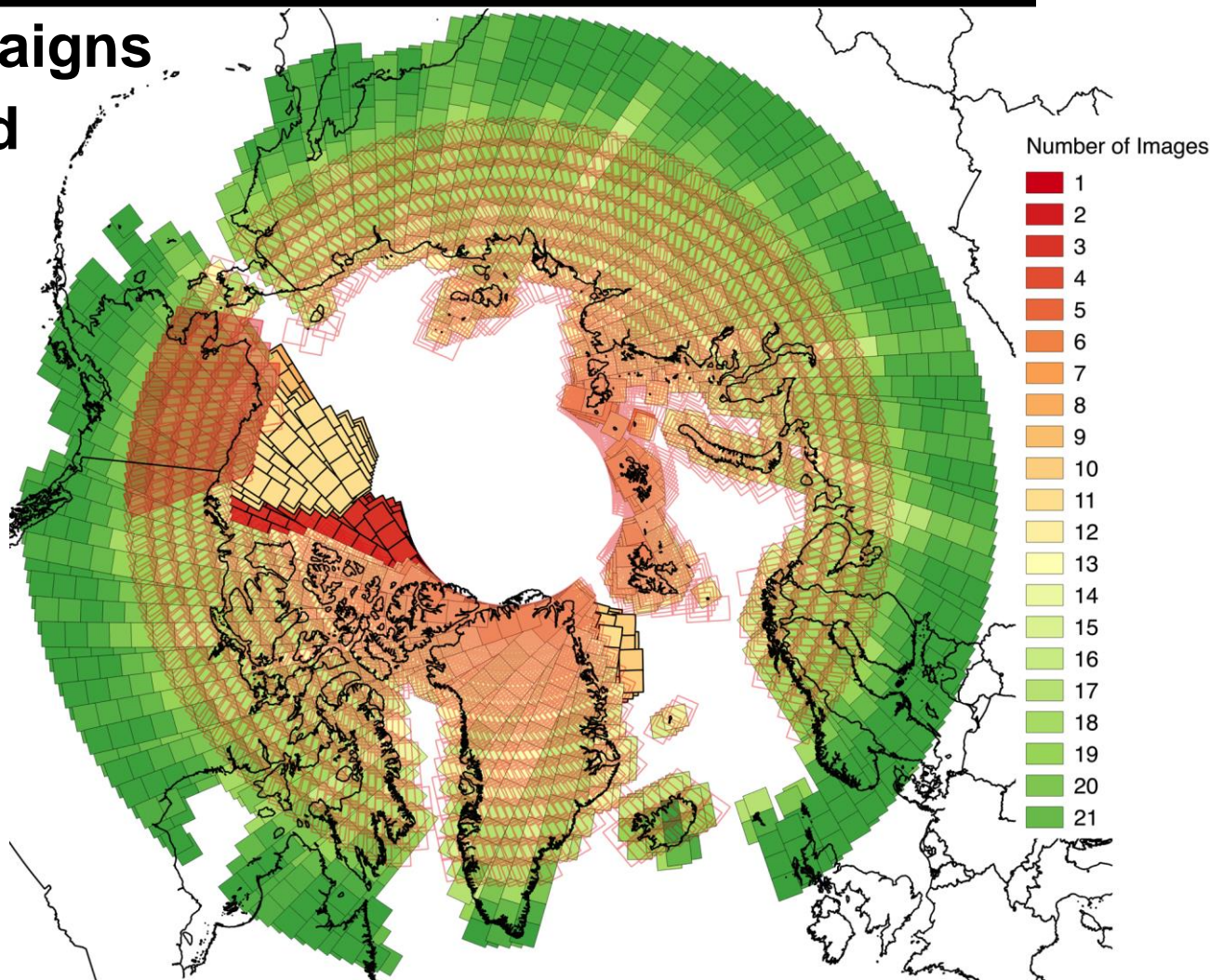


Average number of night images is 12.31



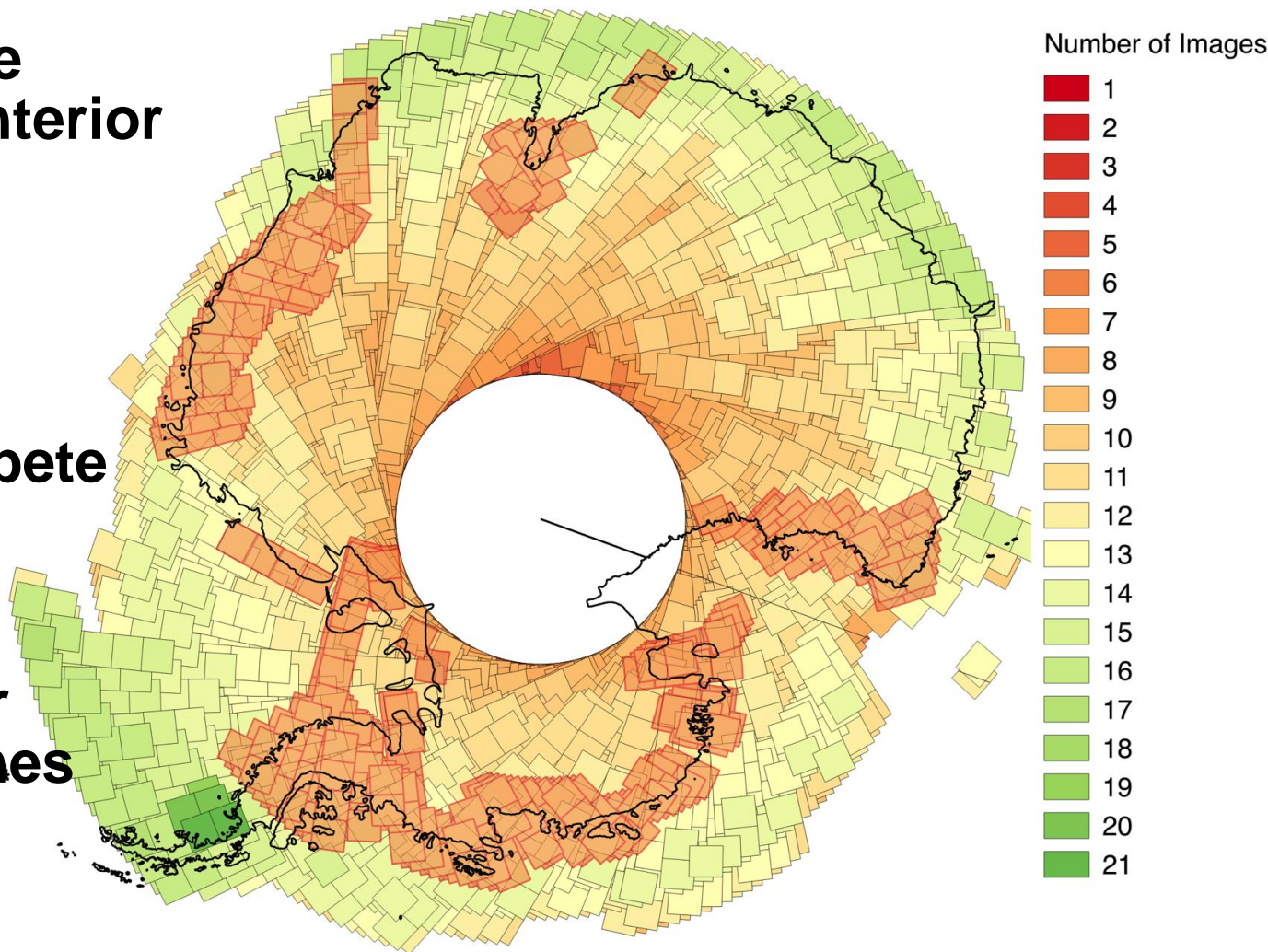
Arctic LTAP and Special Requests

- 3 sea ice campaigns
- Iceland asc and desc
- Asc Alaska campaign
- Average of 650 day-lit candidates
- Considering adding Arctic asc scenes to LTAP at low priority (red outline)



Antarctic LTAP and Special Requests

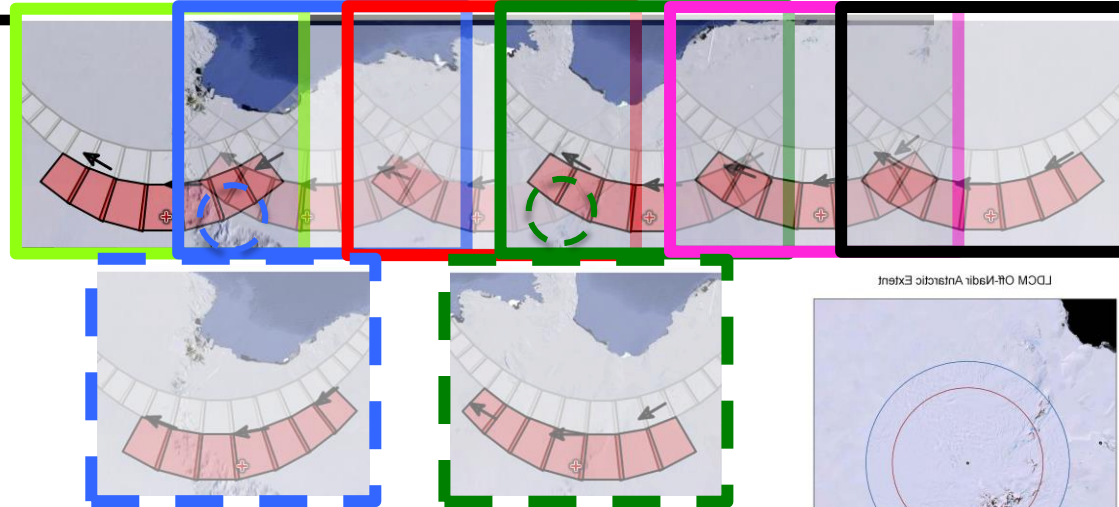
- Acquire once scenes for interior
- Low priority Ascending campaign
- Antarctica scenes compete among themselves and do not impact lower latitude scenes



Antarctic and Arctic Off-nadir Requests

● Antarctica

- ◆ 6 off-nadir paths 60 degree steps
- ◆ 2 off-nadir paths to cover ends of Transantarctic Mountains
- ◆ Expect to repeat variation annually

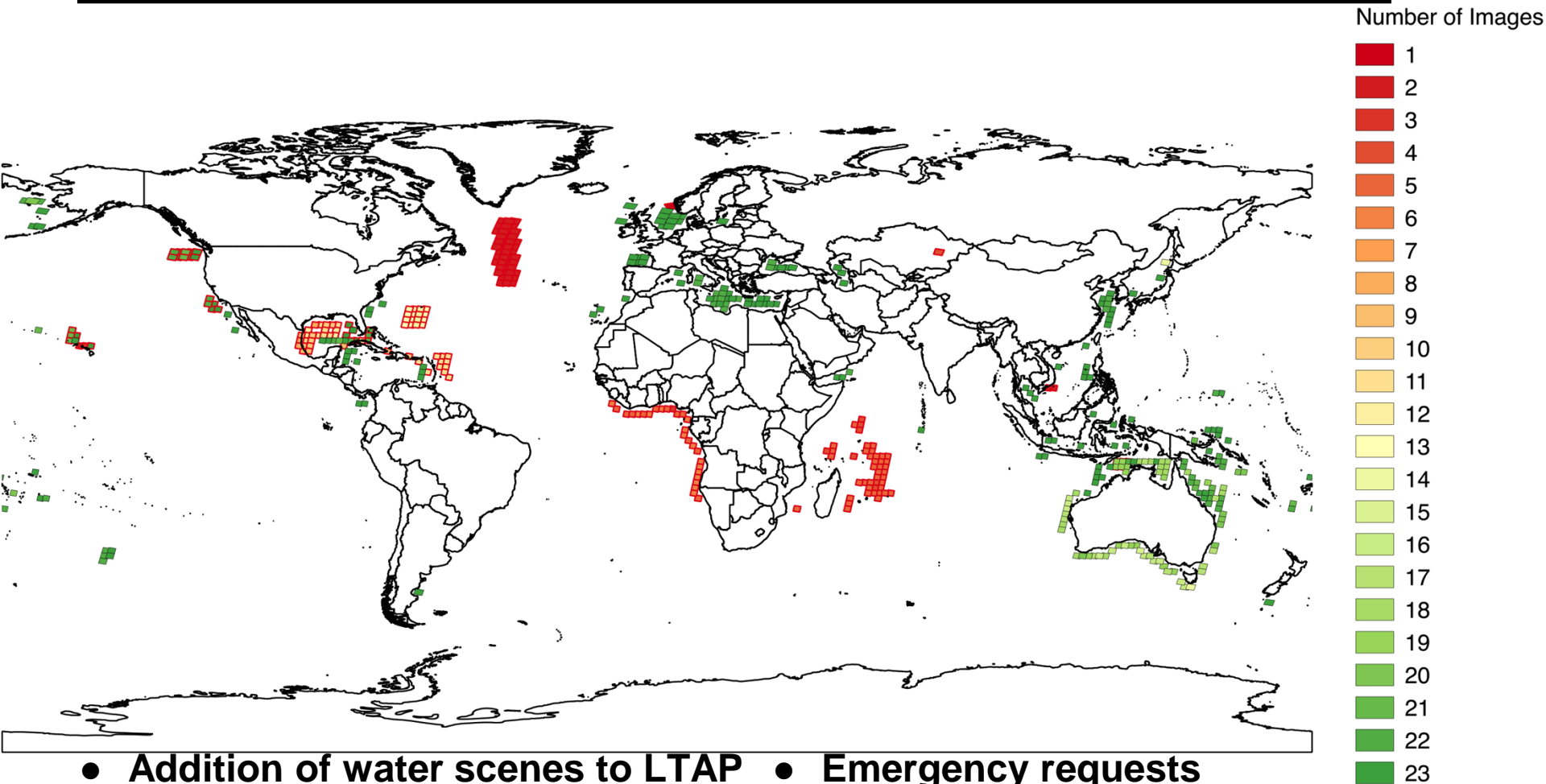


● Arctic

- ◆ 1 off-nadir path
- ◆ Impacts Canada and Scandinavia, but with 8 day asc & desc revisit time

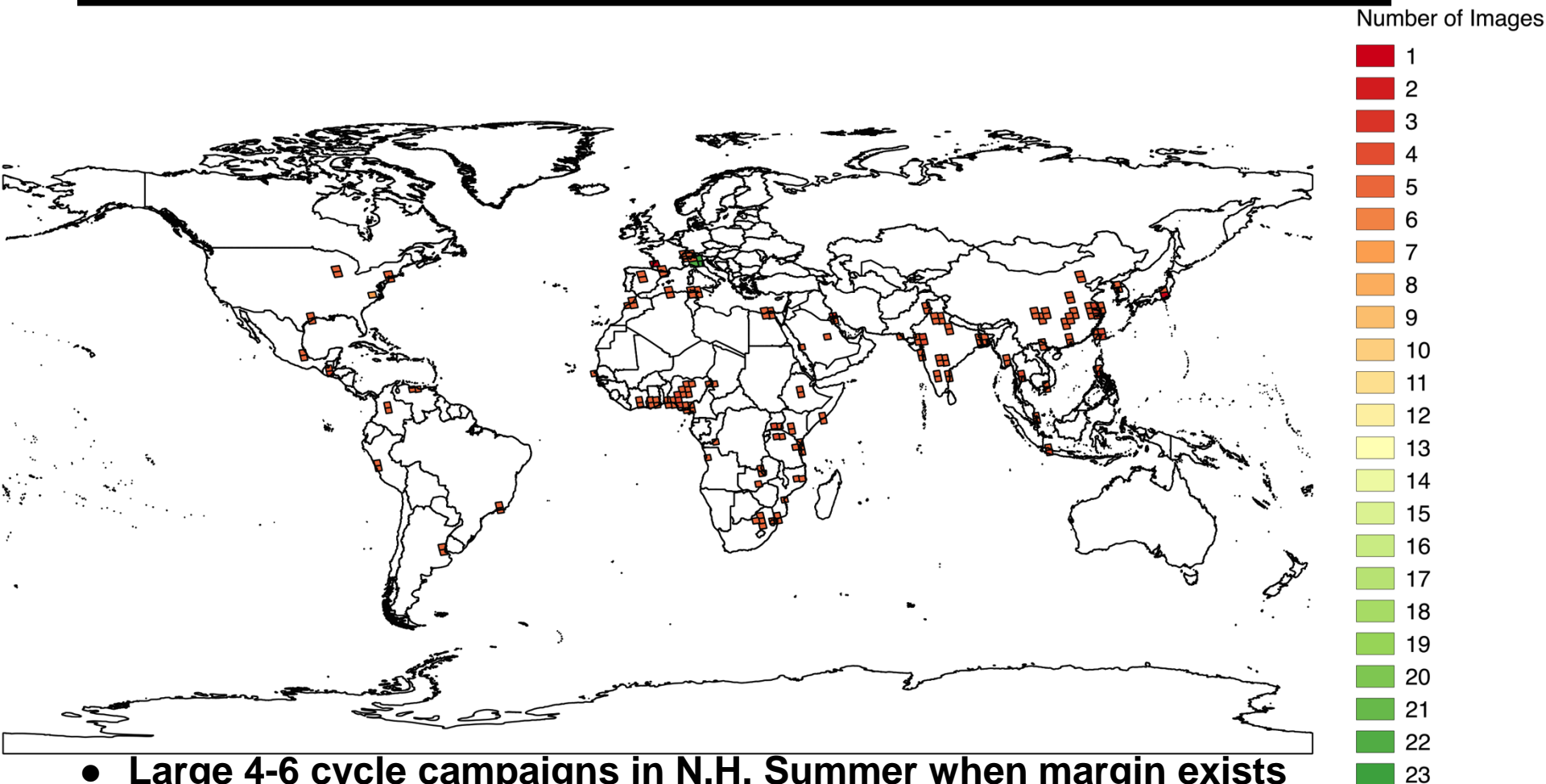


Ocean LTAP and Special Requests



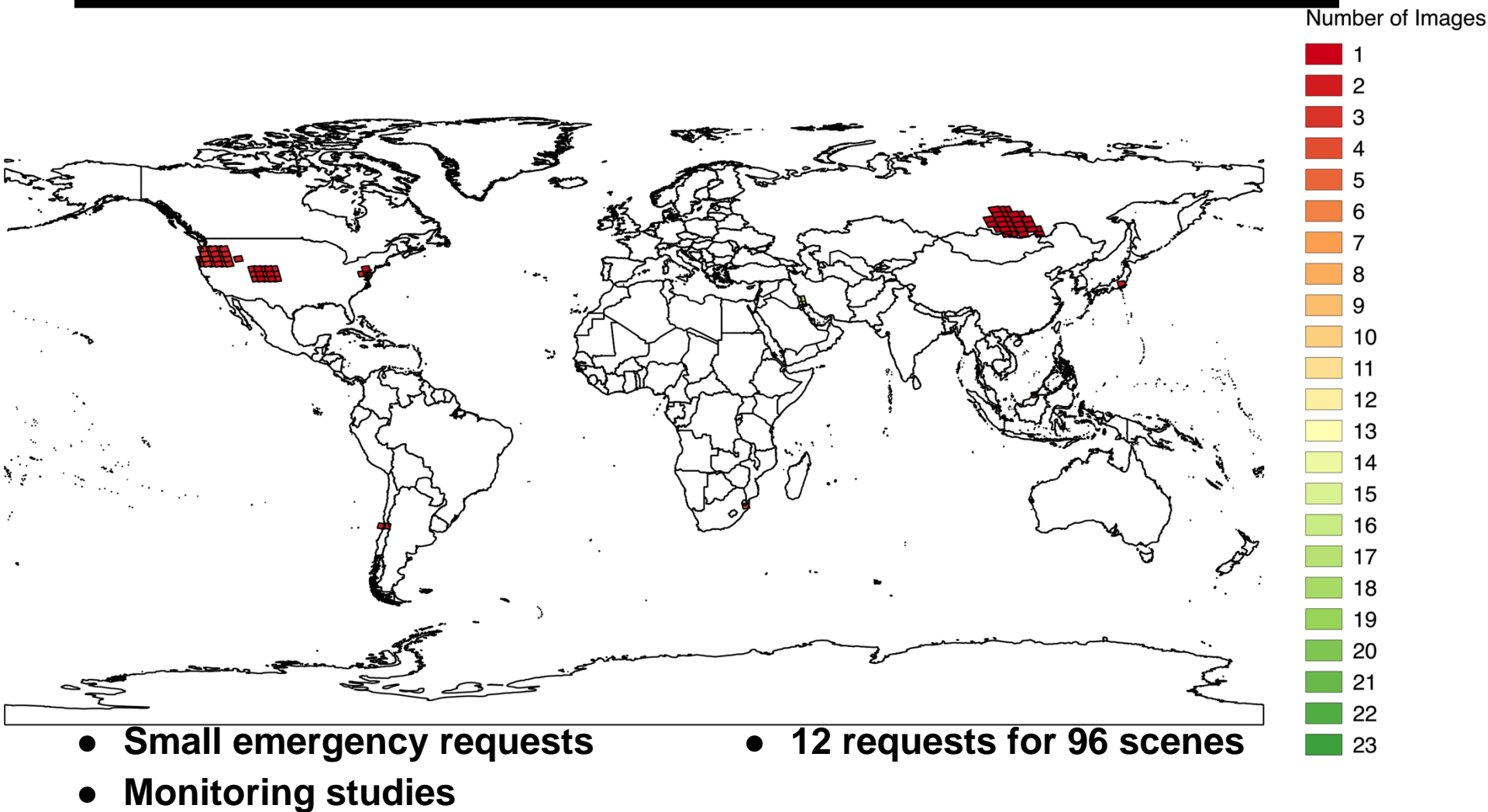
- Addition of water scenes to LTAP
- Long term monitoring campaigns
- Emergency requests
- 10 requests for 181 scenes

Night - Urban Special Requests

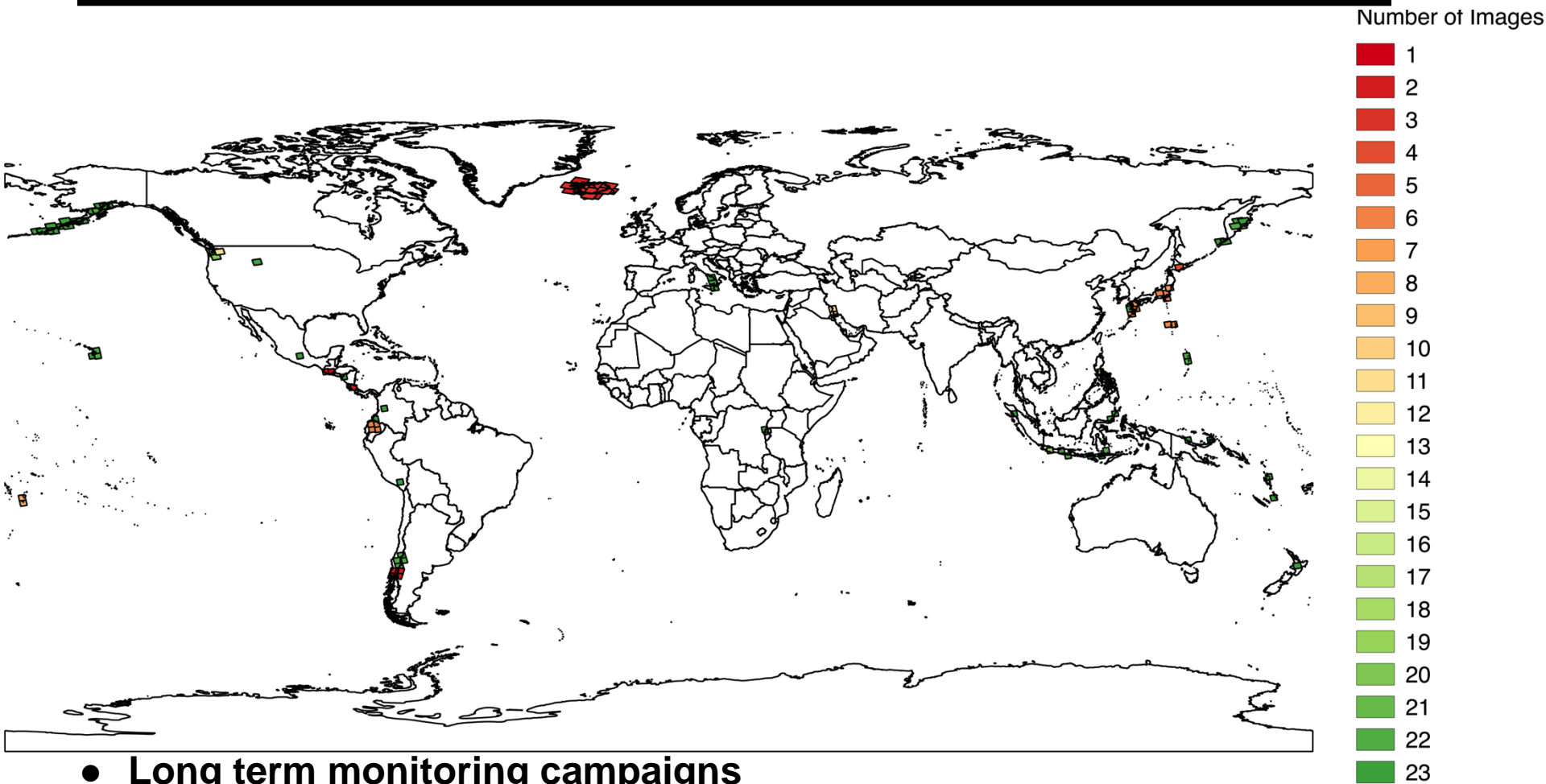


- Large 4-6 cycle campaigns in N.H. Summer when margin exists
- 6 requests for 185 scenes

Night - Fire Special Requests



Night - Volcano Special Requests



- Long term monitoring campaigns
- 12 requests for 128 scenes

An Evolving Scheduling Paradigm

- **Landsat 7**

- ◆ Maximize repeat coverage of continental land masses
- ◆ Maximize health and safety of mission
- ◆ Coordinate acquisitions with Landsat 8
- ◆ Increase ground station contacts and relax duty cycle constraints to maximize acquisitions between now and end-of-mission

- **Landsat 8**

- ◆ Reduce daily-limit rejects for descending day-lit land scenes
- ◆ Continue large ocean, night and ascending campaigns in non-interference manner with day-lit descending land acquisitions
- ◆ Investigate inclusion of ascending Arctic in LTAP at low priority

Questions to Landsat Science Team

- **Importance of Landsat 7**

- ◆ Boreal versus tropical coast
- ◆ Cost (time, money, reliability) for more Ground Stations
- ◆ Acceptable risk for relaxed duty cycle

- **Importance of Landsat 8**

- ◆ Arctic day-lit ascending
- ◆ Night (fire, volcano and urban) and ocean campaigns
- ◆ Antarctica philosophy

Thank You!

Questions?